METHOD AND ARRANGEMENT FOR THE MANUFACTURE OF LIGNOCELLULOSE-CONTAINING BOARDS

FIELD OF THE INVENTION

[0001] The present invention relates to a method of producing boards from lignocellulose-containing material, and to apparatus for carrying out such a method.

BACKGROUND OF THE INVENTION

[0002] Methods of producing boards from lignocellulose-containing raw material are well known in the art, and have found wide use in practice. The manufacture of such boards usually includes the following main method steps: disintegration of the raw material into particles and/or fibers of appropriate size, drying the particles and/or fibers to a predetermined moisture quotient and glue-coating the material either prior to or subsequent to the drying process, shaping the glue-coated material to form a mat, which may comprise several layers, optionally cold-pressing the mat, preheating the mat, water-spraying mat surfaces, etc., and heat-pressing the mat in a discontinuous press or in a continuous press while simultaneously subjecting the material to pressure and heat so as to obtain a finished board. The result will be a board which sometimes includes a thick surface layer with enhanced surface density.

[0003] The boards obtained by this method, e.g. so-called MDF boards (Medium Density Fiberboard) are sometimes used in the production of doors, kitchen cupboard doors, and profiled structural elements such as skirting boards, cornices, window linings, architraving, or furniture components. These structural elements or products are often profiled or patterned, these profiles or patterns being provided in accordance with known technology by milling the profile or pattern into or onto the finished board.

[0004] This method has many drawbacks. For instance, the method involves a production chain and transport chain that consists of many cost-inducing intermediate steps and operations, and which secondly results in a milled product

that will normally have different densities in cross-section, and will therefore absorb different amounts of paint or varnish at different locations, and thirdly milling of the material also results in high material losses. For instance, more than 50% of the starting material can be lost when milling products to pronounced depths.

[0005] Because the board has different densities in the two surface layers subsequent to being worked, the board tends to "warp" when subjected to naturally occurring variations in air humidity.

[0006] In addition, the known methods will normally involve sanding and varnishing, normally with several layers of varnish, or the application of some type of film for priming and/or decorating purposes.

[0007] One object of the present invention is to address these problems. Accordingly, the invention relates to a novel method of avoiding the drawbacks associated with the present-day production process and the many intermediate steps, material transportation and other operations in an economical way.

SUMMARY OF THE INVENTION

[0008] In accordance with the present invention, these and other objects have now been realized by the discovery of a method of manufacturing boards from lignocellulose-containing material comprising forming the lignocellulose-containing material into a mat, compressing the mat to provide a board having a substantially uniform density, forming a pattern on the board by machining the board to provide a patterned board while retaining the substantially uniform density and pressing the patterned board to form a finished board. In a preferred embodiment, the forming of the lignocellulose-containing material into the mat includes disintegrating the lignocellulose-containing material into a plurality of particles or fibers and glue-coating the plurality of particles or fibers.

[0009] In accordance with one embodiment of the method of the present invention, the pressing of the patterned board is carried out while retaining the pattern on the board.

[0010] In accordance with another embodiment of the method of the present invention, the machining of the board comprises at least one milling step.

[0011] In accordance with another embodiment of the method of the present invention, the method includes modifying the patterned board prior to the pressing of the patterned board.

[0012] In accordance with another embodiment of the method of the present invention, the method includes modifying the patterned board during the pressing of the patterned board. Preferably, the modifying of the patterned board comprises applying a sealing surface layer to the patterned board, applying a pre-glued film to the patterned board, or applying a laminate to the patterned board.

[0013] In accordance with another embodiment of the method of the present invention, the method includes applying a further pattern to the patterned board subsequent to the forming of the pattern on the board.

[0014] In accordance with another embodiment of the method of the present invention, the pressing of the patterned board comprises densifying a surface layer of the patterned board.

[0015] In accordance with another embodiment of the method of the present invention, the forming of the pattern on the board includes removing a portion of the lignocellulose-containing material and includes recycling a portion of the lignocellulose-containing material for use in manufacturing the board.

[0016] In accordance with the present invention, apparatus has also been discovered for manufacturing boards from lignocellulose-containing material comprising a pre-press for compressing a mat of the lignocellulose-containing material to provide a board having a substantially uniform density, at least one cutting machine for forming a pattern on the board so as to provide a patterned board while retaining the

substantially uniform density, and a press for pressing the patterned board to form a finished board. In a preferred embodiment, the cutting machine includes at least one milling machine.

[0017] In accordance with one embodiment of the apparatus of the present invention, the apparatus includes surface layer modifying means for modifying a surface layer of the patterned board. Preferably, the apparatus includes laminating means for modifying the patterned board. In a preferred embodiment, the laminating means comprises means for applying reinforcing or sealing material to the patterned board.

[0018] In accordance with another embodiment of the apparatus of the present invention, the press comprises a continuous press including press elements for contacting the patterned board including a pattern corresponding to the pattern formed by the cutting machine.

[0019] In accordance with another embodiment of the apparatus of the present invention, the apparatus includes cutting means for cutting the board into a plurality of board lengths, and wherein the press comprises a discontinuous press including press elements for contacting the plurality of board lengths including a pattern corresponding to the pattern formed by the cutting machine.

[0020] In accordance with another embodiment of the present invention, the press includes densifying means for densifying a surface layer of the patterned board.

[0021] Thus, in accordance with the present invention, a method is provided for subjecting a board between a first step, in which the shaped mat is compressed to a board that has an essentially uniform density, and a second step in which the board is pressed to a finished board, to an intermediate step in the form of at least one machining operation comprising cutting in order to obtain a pattern on or in the board while retaining its generally uniform density. The present invention thus affords the advantage that the machining operation in which a pattern is cut on or in the

board forms part of the production process as an intermediate step prior to finally pressing the board to a finished state. This avoids the expensive transportation and handling operations that are required when the corresponding operation is performed on a finished board.

[0022] One important characteristic feature of the board produced by the present invention is that the board has an essentially uniform density both before and after the machining operation, i.e. a so-called straight density profile, which means that the density is essentially the same across the full cross-section/thickness of the board. The machining and patterning operation thus will not result in any appreciable change in the density of the board. This affords the advantage that the material will be the same across the whole board even after having patterned the board, which simplifies and lowers the cost of subsequent operations, such as painting, varnishing or applying a different material to enhance the mechanical strength of the board or for decoration purposes, among other things. The uniform and unaffected density also has the advantage of reducing the risk of the board warping, by virtue of the fact that the board will absorb moisture uniformly.

[0023] Reference is made to Swedish Patent Nos. 502,272 and 504,221 with respect to the manufacture of uniform density board, these patents describing methods for obtaining boards of uniform density.

[0024] Pressing of the board in the second step of the process is carried out in a manner to retain the pattern obtained by the machining operation and may either be performed in a continuous press or in a batch-wise press, so-called discontinuous press, with hot rolls or press plates that include the intended pattern.

[0025] The boards are preferably machined in one or more milling operations. Other types of mechanical working of the board, however, are conceivable such as sanding or grinding,

for instance. Naturally, a combination of several board machining or working operations may be applied.

[0026] According to one embodiment of the present invention, the surface layer of the board is modified prior to the second process step but after the machining operation.

[0027] According to an alternative embodiment of the present ivneiton, the surface layer of the board is modified in conjunction with the second step.

[0028] Modification of the surface layer of the board may include applying a pre-glued film to the board, or placing a laminate on the board either before pressing the board in the second step or in conjunction therewith, for instance. The film or laminate will then harden firmly to the board, to form a sealing and strengthening layer in the hot pressing operation.

[0029] According to another embodiment of the present invention, a densified surface layer may be produced on the board when pressing the board in the second process step, e.g. in accordance with known technology at high pressures and heat transfer at the beginning of the press cycle.

[0030] These embodiments may, of course, be mutually combined in different ways. All of these embodiments include the possibility of applying a further pattern to the board, such as to give the board a certain surface structure or texture, such as a grain structure or texture.

[0031] Examples of methods of providing a board with a densified surface layer or a sealing surface layer are described in the aforementioned Swedish patent publications.

[0032] The present inventive method also has the advantage of enabling material that is cut away by milling or otherwise removed in the machining operation to be returned to the flow of raw material in the board manufacturing process.

[0033] Finally, the present invention also relates to a corresponding arrangement for carrying out the method hereof comprising an arrangement for carrying out the first step that includes a pre-press in which a mat is compressed to form a

board of generally uniform density, and at least one station which includes a cutting machine for carrying out the intermediate step, and further comprising a press for carrying out the second step.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] The present invention will now be described in more detail with reference to the exemplifying embodiments set forth in the following detailed description, which, in turn, refers to the accompanying drawings, in which:

[0035] Figure 1 is a side, elevational, schematic view of a board manufacturing method in accordance with a first embodiment of the present invention with continuous pressing of the board;

[0036] Fig. 2a is a side, elevational view of a pattern obtained by means of the method illustrated in Fig. 1;

[0037] Fig. 2b is a side, elevational view of another pattern obtained by means of the method illustrated in Fig. 1;

[0038] Fib. 2c is a top, elevational view of another pattern obtained by means of the method illustrated in Fig. 1;

[0039] Figure 3 is a side, elevational, schematic view of a method for producing boards in accordance with a second embodiment of the present invention with pressing of the board in a discontinuous press;

[0040] Fig. 4a is a top, elevational view of a pattern obtained by milling and stepwise pressing in a discontinuous press; and

[0041] Fig. 4b is a side, elevational, cross-sectional view of the object in Fig. 4a, where the milling operations are illustrated.

DETAILED DESCRIPTION

[0042] The process illustrated in Fig. 1 for the manufacture of boards from lignocellulose-containing material, in accordance with a first embodiment, includes a first process stage in the form of a pre-press 1, an intermediate stage that includes milling stations 2, and a second stage that includes a continuous press 3. Stage one includes a belt

press 1, shown in side view, which typically includes drive rolls 6, stretch rolls 7, guide rolls 8 and an adjustable inlet part 9 that includes infeed rolls (not shown), steam roll 10, and a holding section 12 comprising compression roll and further rolls (not shown), and a surrounding wire 14, or alternatively a perforated steel belt with a wire. The mat 4 fed into the inlet section 9 is compressed to a predetermined density. The glue hardens/cures in the mat in the holder section 12, such as to obtain board that has a uniform density profile. As an example, the density of the board may be from about 150 to 900 kg/m^3, and preferably from about 500 to 700 kg/m^3. A higher density, in the order of from about 800 to 900 kg/m^3, is used in the manufacture of thin boards. In the illustrated case, the holding section 12 is followed by a conditioning unit 16 in which steam and press gases are dealt with.

[0043] After having passed through stage one, the compressed mat 4 is fed into board milling stations 2, in which the pattern desired, in the form of surface patterns, profiled strips or the like, are milled in the board.

[0044] Subsequent to these milling operations, the board is passed into a continuous press 3, which includes the second process stage. The rolls 20 of this press have the same pattern as the milled pattern, so as to ensure that the milled pattern will not be destroyed as the board is pressed. A sealing surface layer can be obtained on the board beneficially in this way. Alternatively, the surface layer of the board can be further reinforced by applying a pre-glued film or a laminate to the machined board prior to the board entering the second press stage. This alternative is illustrated in Fig. 1 with a laminate feed mill 22. The rolls may have a surface temperature of between about 100°C and 300°C, preferably between about 150°C and 250°C.

[0045] Figs. 2a-2c illustrate respective examples of different patterns that can be obtained with the aid of the milling stations in a continuous board pressing process. Figs.

2a and 2b show respective examples of patterns transverse to the longitudinal axis of the board, while Fig. 2c shows an example of a pattern formed in the longitudinal direction of the board. Naturally, many other types of patterns are conceivable within the scope of the present invention.

[0046] The embodiment illustrated in Fig. 3 is concerned with the manufacture of boards in accordance with the present invention, wherein the second stage is comprised of a discontinuous press in which boards that have been cut to length are pressed in a batch-wise manner. Stage 1 is not illustrated in Fig. 3, but may be carried out in the manner illustrated in Fig. 1 or in some other way, for instance in accordance with the aforesaid Swedish patent specifications. The mat 34 compressed to form a board in the first stage is delivered after that stage to a saw 30 that saws the board into board parts of a size suitable for the discontinuous press. After having been sawed to size, the boards are transported to a milling station 32 in which the desired pattern or patterns are milled on the board. Subsequent to the milling process, respective boards are advanced to the discontinuous press 33 and fed thereinto for batch-wise pressing. According to a preferred embodiment of the present invention, a surface layer reinforcing laminate is applied to the board prior to the pressing operation. The laminate is delivered from a laminate feed mill 52. The discontinuous press has press plates that include the intended pattern, i.e. the same pattern as that obtained in the milling operations, so that said pattern will be retained as the board is pressed. Optionally, the board may be given a further pattern, for instance in the form of a surface structure. The press plates will preferably have a surface temperature that lies within the same range as that mentioned with respect to the rolls in the first embodiment illustrated in Fig. 1.

[0047] Finally, Fig. 4a shows an example of a pattern obtained in the plant illustrated in Fig. 3. The object illustrated may be the door of a kitchen cupboard or cabinet,

or a door of some other kind. The door 60 is shown in cross-section in Fig. 4b and in an enlarged view taken on line A-A in Fig. 4a. In the Fig. 4b illustration, a bevelled surface has been milled on the door around its perimeter edge. The door has also been provided with a grooved profile 62 spaced from said outer edge.

[0048] Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

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